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None

(58) Field of search
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INT CL^{5} B66B, G05D
Online databases: WPI

(54) **Apparatus for and method of controlling speed of elevator**

(57) An apparatus for controlling a motor speed of an elevator, capable of efficiently restraining a vibration occurring at a cage, comprises a subtractor for deriving a signal indicative of a difference between a speed detecting signal and a speed command signal, a proportional integrator 112 for proportionally integrating an output signal from the subtractor, a notch filter 113 for removing a particular frequency component from an output signal from the proportional integrator and outputting the signal free of the particular frequency component as a motor speed control signal, and a vibration control circuit 114 for varying a constant of a transfer function of the notch filter, based on a position of a cage equipped in the elevator and a load of the cage. The speed detecting signal is generated by a speed detector for detecting a rotation speed of a sheave and the speed command signal is generated by the vibration control circuit.

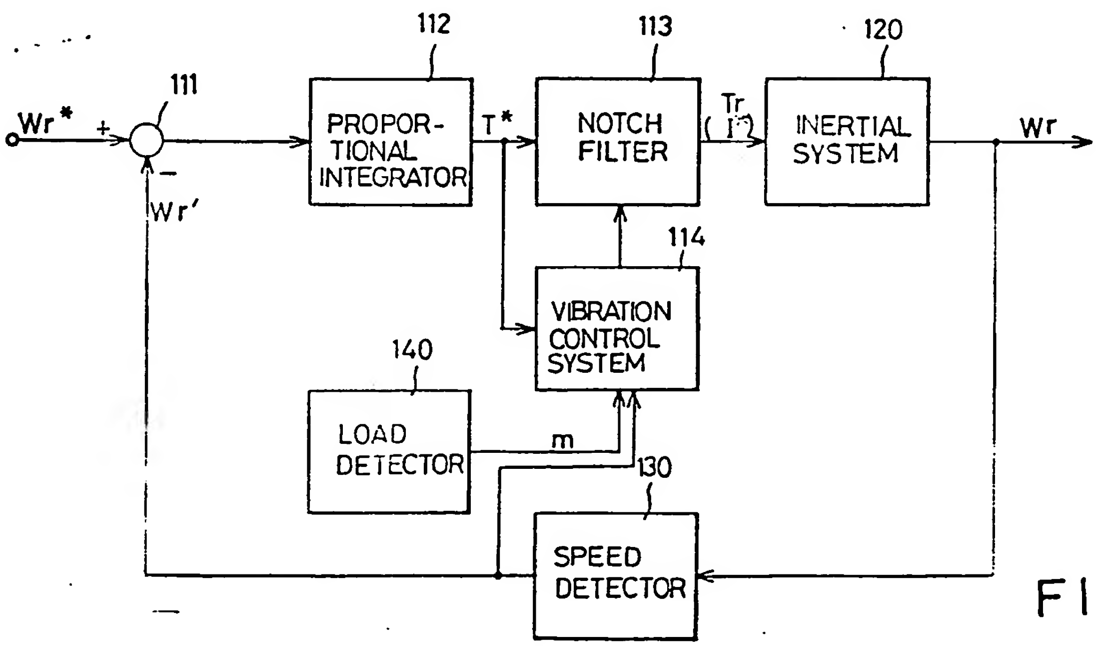

FIG. 3

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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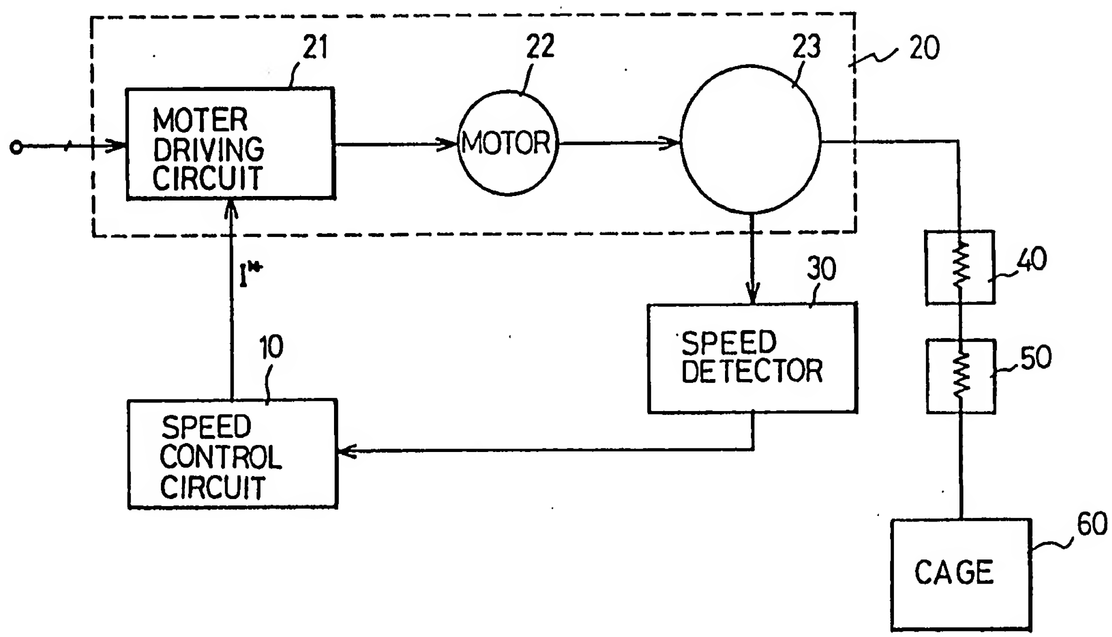
FIG. 1



MOTER DRIVING CIRCUIT
MOTOR
SPEED DETECTOR
SPEED CONTROL CIRCUIT
CAGE
I*
10
20
21
22
23
30
40
50
60

FIG. 2

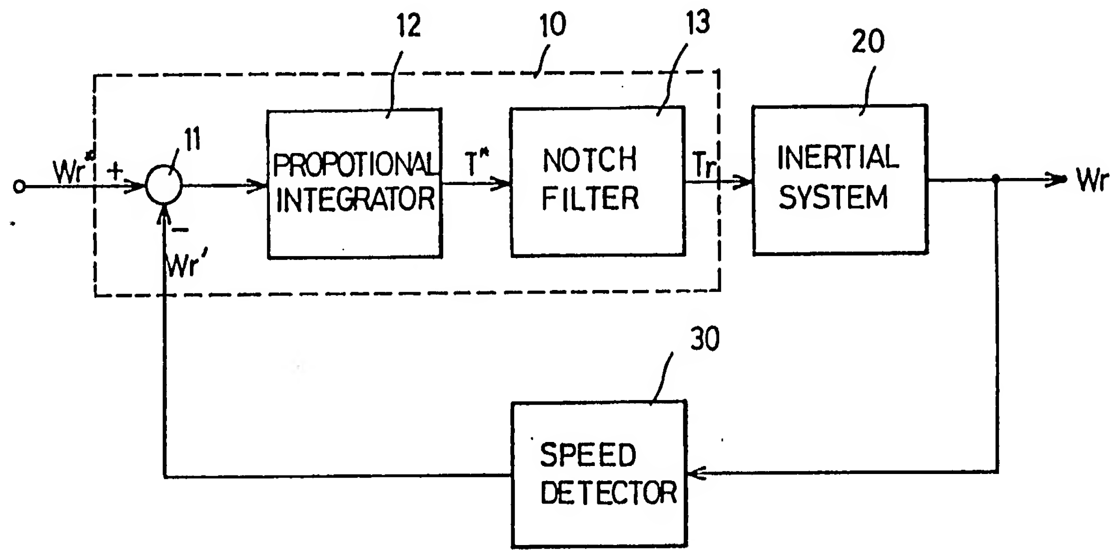

Wr*
+
11
−
Wr'
12
PROPOTIONAL
INTEGRATOR
T*
10
13
NOTCH
FILTER
Tr
20
INERTIAL
SYSTEM
Wr
30
SPEED
DETECTOR

FIG. 3

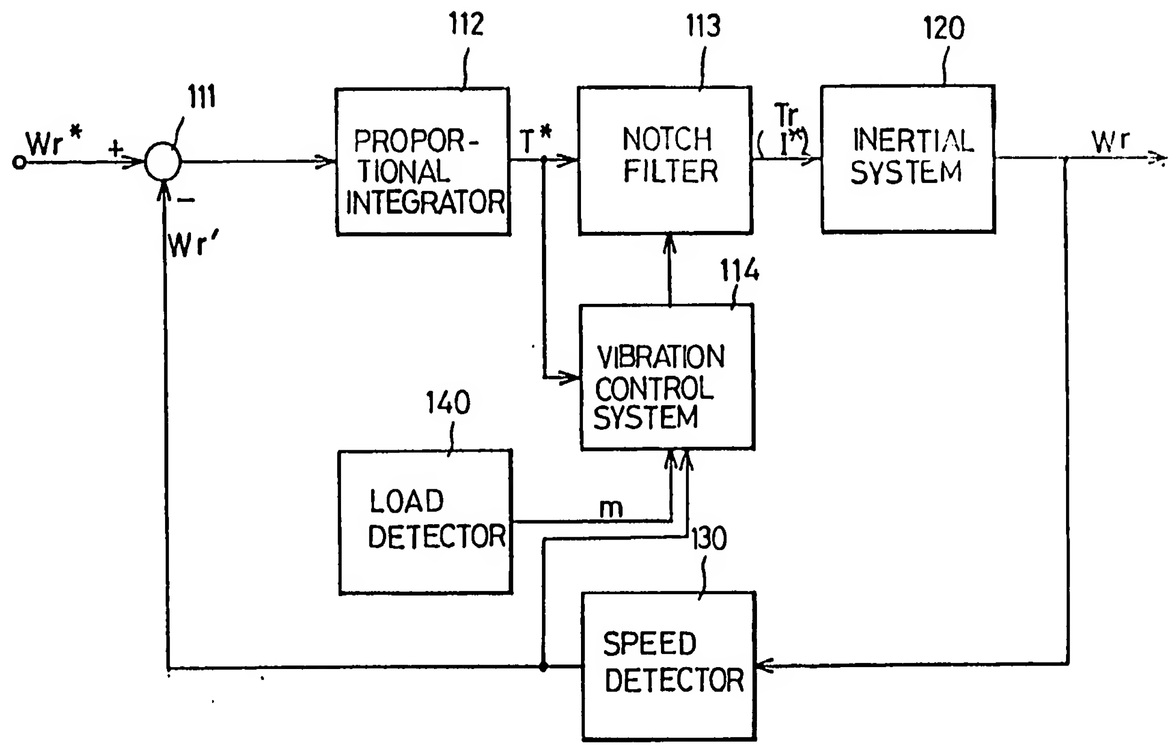

111
112
113
120
114
140
130
Wr*
+
−
Wr′
PROPOR-
TIONAL
INTEGRATOR
T*
NOTCH
FILTER
Tr
(T*)
INERTIAL
SYSTEM
Wr
VIBRATION
CONTROL
SYSTEM
LOAD
DETECTOR
m
SPEED
DETECTOR

FIG.4

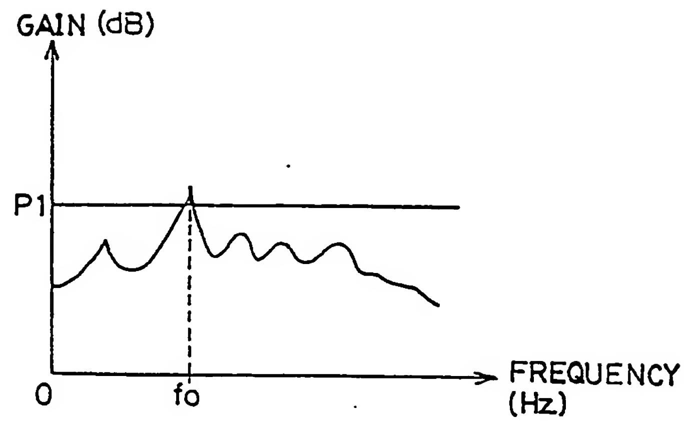


FIG.5

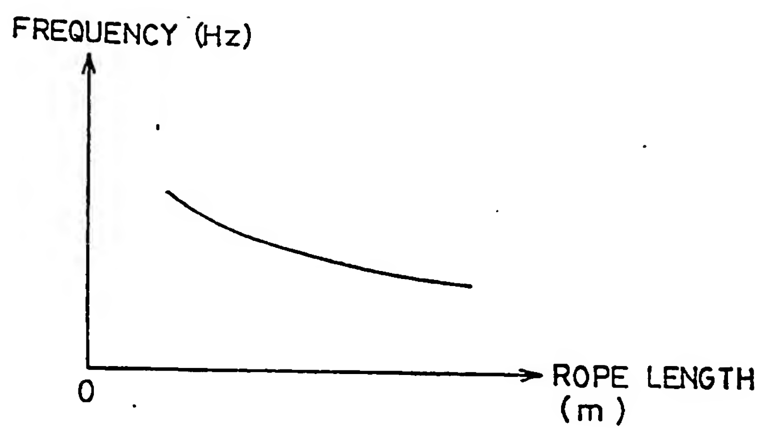


FIG.6

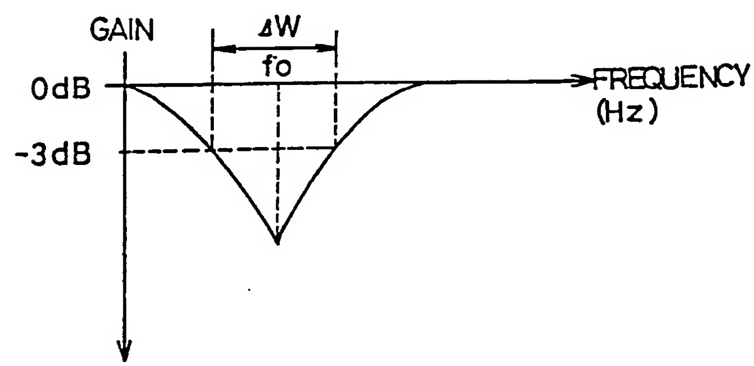

GAIN
ΔW
fo
0dB
-3dB
FREQUENCY
(Hz)

FIG.7

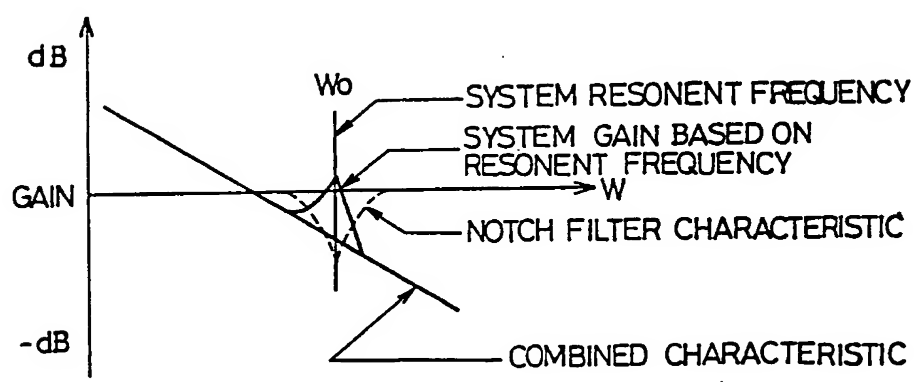
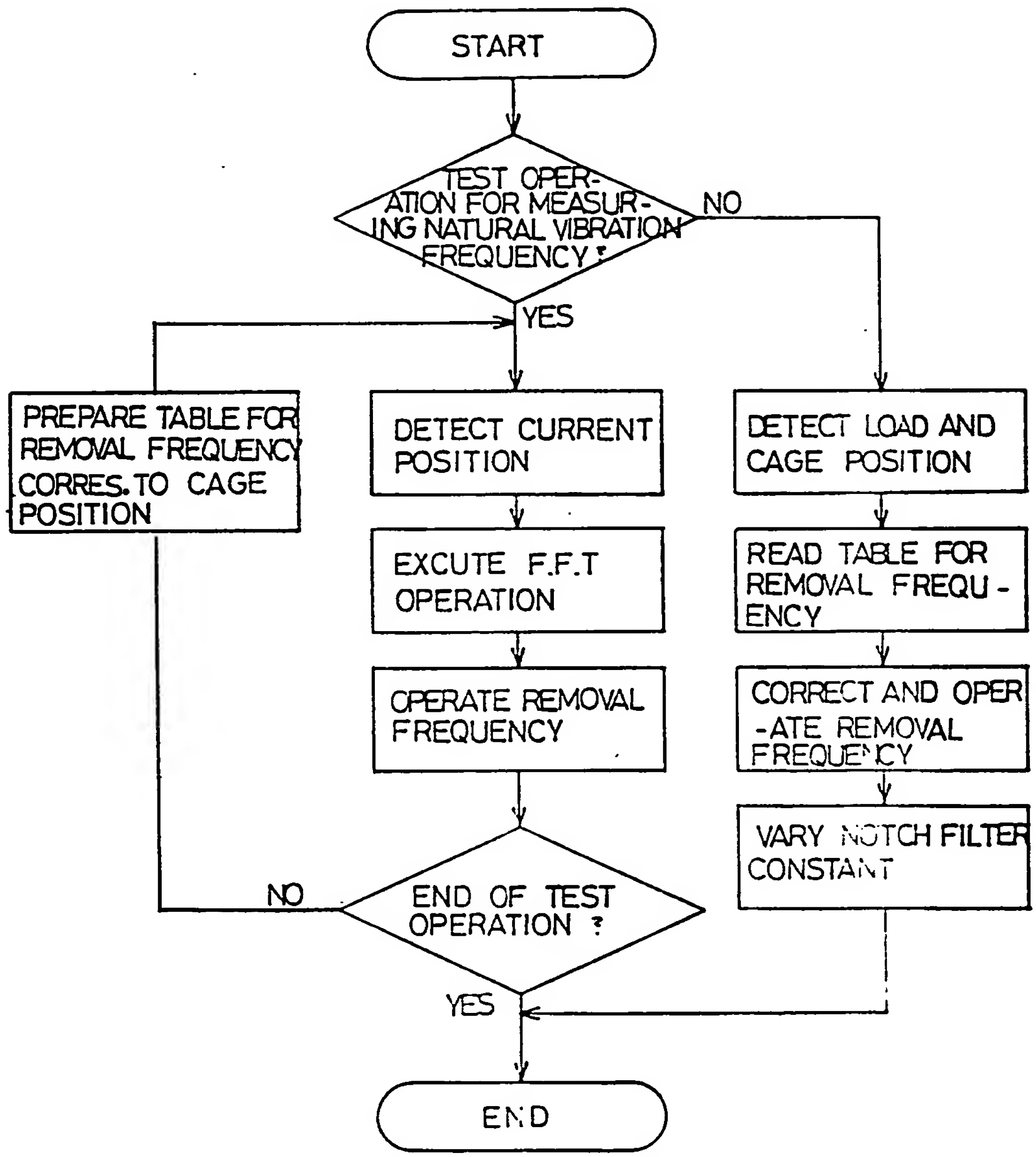

dB
Wo
SYSTEM RESONENT FREQUENCY
SYSTEM GAIN BASED ON
RESONENT FREQUENCY
GAIN
W
NOTCH FILTER CHARACTERISTIC
-dB
COMBINED CHARACTERISTIC

FIG. 8


START
TEST OPERATION FOR MEASURING NATURAL VIBRATION FREQUENCY ?
NO
YES
PREPARE TABLE FOR REMOVAL FREQUENCY CORRES. TO CAGE POSITION
DETECT CURRENT POSITION
EXCUTE F.F.T OPERATION
OPERATE REMOVAL FREQUENCY
END OF TEST OPERATION ?
NO
YES
DETECT LOAD AND CAGE POSITION
READ TABLE FOR REMOVAL FREQUENCY
CORRECT AND OPERATE REMOVAL FREQUENCY
VARY NOTCH FILTER CONSTANT
END

2266976

APPARATUS FOR AND METHOD OF CONTROLLING SPEED OF ELEVATOR

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a speed control for an elevator, and more particularly to an apparatus for and a method of controlling a speed of a gearless type elevator.

Description of the Prior Art

In cases of elevators of a gearless type wherein a rotation force of a motor is directly transmitted to a sheave, without using no reduction gearing, to move a cage, a vibration may occur at the cage, due to natural vibrations of a rope and a thimble rod spring. Such a vibration becomes more severe by a resonance occurring at a speed control unit, so that the passenger's feeling is hurt.

For restraining such a vibration occurring at the cage, a notch filter has been conventionally used for reducing a gain of a speed control system, based on natural vibration frequencies of the rope and thimble rod spring.

Referring to FIG. 1, there is illustrated a conventional speed control system for an elevator. As shown in FIG. 1, the speed control system comprises a motor driving circuit 21 for outputting an electric power for energizing a motor 22, based

on a current command signal for controlling a rotation speed of the motor 22 and a sheave 23 operatively connected to rotate by a rotation force of the motor 22, for winding a rope connected with a cage 60 thereon and unwinding it therefrom. The speed control system also comprises a speed detecting circuit 30 for detecting a rotation speed of the sheave 23 and a speed control circuit 10 for outputting a current command signal I* at the motor driving circuit 21, so as to make the rotation speed of the sheave 23 correspond to a speed command signal Wr* generated from a main control panel (not shown), based on a difference between the speed command signal Wr* and a speed detecting signal Wr' from the speed detector 30.

As shown in FIG. 2, the speed control circuit 10 comprises a subtractor 11 for subtracting the speed detecting signal Wr' outputted from the speed detector 30 from the motor speed command signal Wr* outputted from a speed controlling computer (not shown), a proportional integrator 12 for proportionally integrating an output signal from the subtractor 11, and a notch filter 13 for removing a particular frequency component from an output signal of the proportional integrator 12 and outputting the output signal free of the particular frequency component as the current command signal.

In FIG. 1, the reference numeral denotes a thimble rod spring and the reference numeral 20 denotes an inertial system which includes the motor driving circuit 21, the motor 22 and

the sheave 23, all being expressed by dynamics.

Operation of the speed control circuit of the conventional elevator will now be described.

When the speed control computer generates a speed command signal Wr* for driving the cage 60 at a predetermined speed, the speed control circuit 10 outputs a current command signal I* for controlling the speed of the motor 22, based on the speed command signal Wr*. According to the current command signal I*, the motor driving circuit 21 outputs an electric power for energizing the motor 22, so that the motor 22 is driven, based on the speed command signal Wr*. The rotation force of the motor 22 is transmitted to the sheave 23, thereby causing the sheave 23 to rotate. The rotation of sheave 23 causes the rope 40 to move for moving the cage 60 vertically.

When the cage 60 moves vertically by the rotation of sheave 23, a vibration occurs at the cage 60 due to natural vibrations of the rope 40 and the thimble rod spring 50. This vibration brings the rotation speed Wr of the sheave 20 to vary.

At this time, the speed detector 30 detects the rotation speed of sheave 23 and generates a corresponding speed detecting signal Wr' which is, in turn, applied to the subtractor 11 of the speed control circuit 10. The speed control circuit 10 subtracts the received speed detecting signal Wr' from the speed command signal Wr* and generates a

signal indicative of a difference between the speed command signal Wr* and the speed detection signal Wr'. The difference signal is proportionally integrated in the proportional integrator 12 which, in turn, outputs the resultant signal at the notch filter 13. Since the output signal of the proportional integrator 12 carries a variation in speed generated due to the vibration, the notch filter 13 removes a particular frequency component from the output signal and then sends the resultant signal to the motor driving circuit 21 of the inertial system 20, as a torque-controlling current command signal I*.

Accordingly, when the sheave 23 varies in rotation speed, due to the vibration of the cage 60 caused by the natural vibrations of the rope 40 and thimble rod spring 50, this variation in rotation speed is detected by the speed detector 30. Also, the speed control circuit 10 decreases a gain of the particular frequency through the notch filter 13 so that a current command signal I* with speed deviation corrected is sent to the motor driving circuit 21, so as to control the rotation force of the motor 22. Thus, the vibration occurring at the cage 60 is restrained.

The natural vibration frequency fo of the rope 40 and thimble rod spring 50 resulting in a vibration at the cage 60 can be expressed by the following approximate equation:

$$fo = \frac{1}{2\pi} \frac{K}{m} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (1\text{-}1)$$

wherein, K represents an elastic coefficient and m represents a mass of the cage 60.

The elastic coefficient K based on the vibration of the cage 60 can be expressed using an elastic coefficient K_ℓ of the rope 40 and an elastic coefficient K_T of the thimble rod spring 50 as follows:

$$K = \frac{K_\ell \cdot K_T}{K_\ell + K_T} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (1\text{-}2)$$

Also, the elastic coefficient K_ℓ of the rope 40 is approximately proportional to the product of a cross-sectional angel A of the rope 40 and Young's modulus E and approximately inversely proportional to the length l of the rope 40. Accordingly, it can be expressed as follows:

$$K_\ell = \frac{A \cdot E}{l} = \frac{C}{l} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (1\text{-}3)$$

When the equation (1-2) is substituted for the equation (1-1), following a substitution of the equation (1-3) therefor, the natural vibration frequency fo can be expressed

by the following equation:

$$fo = \frac{1}{2\pi} \cdot \frac{1}{m} \times \frac{C \cdot K_T}{C + K_T \cdot l} \quad \cdots\cdots\cdots\cdots (1\text{-}4)$$

As apparent from the equation (1-4), the natural vibration frequency fo of the rope 40 and cage 60 based on the dynamics involves the mass m of the cage 60 and the length l as its parameters.

Also, a transfer function of the notch filter 13 which has received an output T* of the proportional integrator 12 carrying a variation in speed caused by the natural vibration frequency fo expressed by the equation (1-4) can be expressed as follows:

$$G_N(S) = \frac{S^2 + W^2}{S^2 + \frac{Wo}{Q} S + Wo^2} \quad \cdots\cdots\cdots\cdots (1\text{-}5)$$

wherein, Q = Wo/ W (W: a bandwidth of a removal frequency) and Wo = 2πfo.

The notch filter 13 resonates the natural vibration frequency by a resonant frequency based on a fixed angular velocity Wo so that the natural vibration frequency is removed according to a combined characteristic of two frequencies. As

a result, the output T* of the proportional integrator 12 received in the notch filter 13 becomes free of a particular frequency and is then applied to the inertial system 20, as a new torque-controlling current command signal.

Accordingly, the inertial system 20 controls the rotation force of the motor 22, based on the output from the notch filter 13, so that it decreases a variation in speed of the sheave 23, thereby restraining the vibration of the cage 60 caused by the system resonance.

However, the natural vibration frequency fo varies, depending on a variation in cage mass which is caused by variations in cage load and rope stroke length. That is, the natural vibration frequency becomes different in all the cases of idle top stairs, idle bottom stairs, full load top stairs and full load top stairs.

Conventionally, such a variation in natura vibration frequency caused by the variation in load of the cage makes it impossible to effectively restrain the vibration, since Q and Wo of the transfer function are fixed as constants. As a result, the operator should measure directly the natural vibration frequency fo to change the constants. However, such a manipulation is very troublesome.

SUMMARY OF THE INVENTION

Therefore, the present invention has been made in view of the above-mentioned problems encountered in the prior art and an object of the invention is to provide an apparatus for and a method of controlling a speed of an elevator, capable of automatically varying a transfer function constant of a notch filter, correspondingly to both the cage mass and the rope length and thus effectively restraining a vibration of the elevator.

In accordance with one aspect, the present invention provides an apparatus for controlling a speed of an elevator comprising: a subtractor for subtracting a speed detecting signal from a speed command signal; a proportional integrator for proportionally integrating an output signal from said subtractor; a notch filter for removing a particular frequency component from an output signal from said proportional integrator and outputting said signal free of said particular frequency component as a torque-controlling current command signal; and vibration control means for varying a constant of a transfer function of said notch filter, based on a position of a cage equipped in the elevator and a load of said cage. The vibration control means is a microcomputer which is adapted to receive a speed detecting signal indicative of a sheave equipped in the elevator, a load detecting signal

indicative of said load of the cage and an output signal from the proportional integrator, vary said constant, based on said received signals, and send the varied constant to the notch filter.

In accordance with another aspect, the present invention also provides a method of controlling a speed of an elevator comprising the steps of: a) determining whether a current operation is a test operation for measuring respective natural vibration frequencies corresponding to cage positions or a normal operation; b) if said current operation is said test operation, storing, in a table, a removal frequency of natural vibration frequencies of a rope and thimble rod spring at each position of a cage equipped in the elevator while controlling a speed of a driving motor equipped in said elevator without using a notch filter; c) if the current operation is said normal operation, varying a constant of a transfer function of said notch filter, based on a current position of a cage equipped in the elevator and a current load of said cage; said step (b) comprising: detecting cage positions at predetermined intervals; operating natural vibration frequencies through a fast Fourier transform for a signal obtained by proportionally integrating a signal indicative of a difference between a speed command signal and a speed detecting signal both generated for each of said cage positions; and finding a removal frequency from said natural vibration frequencies for

each cage position and storing said removal frequency in said table, together with each cage position corresponding thereto; and said step (c) comprising: detecting said current cage position and said current cage load; reading a removal frequency previously stored in the table and corresponding the current cage position; correcting and operating said read removal frequency corresponding to the current cage position, based on the current cage load; and varying said constant of said transfer function, based on said corrected and operated frequency and a bandwidth of said removal frequency previously stored.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and aspects of the invention will become apparent from the following description of embodiments with reference to the accompanying drawings in which:

FIG. 1 is a block diagram of a conventional speed control system for an elevator;

FIG. 2 is a block diagram of a speed control circuit employed in the conventional speed control system of FIG. 1;

FIG. 3 is a block diagram of an apparatus for controlling a speed of an elevator, in accordance with an embodiment of the present invention;

FIG. 4 is a graph illustrating a relationship between a

gain and a frequency in the case of FIG. 3;

FIG. 5 is a graph illustrating a relationship between the rope length and the natural vibration frequency in the case of FIG. 3;

FIG. 6 is a diagram illustrating a characteristic of the notch filter in the case of FIG. 3;

FIG. 7 is a diagram illustrating a gain characteristic depending on a vibration restraint in the case of FIG. 3; and

FIG. 8 is a flow chart illustrating a vibration restraint operation of the apparatus of FIG. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 3, there is illustrated an apparatus for controlling a speed of an elevator, in accordance with an embodiment of the present invention.

As shown in FIG. 3, the speed control apparatus comprises an inertial system 120 which includes a motor driving circuit, a motor and a sheave. The inertial system 120 is adapted to drive a cage to move vertically, by directly transmitting a rotation force of the motor to the sheave and thus moving a rope according to a rotation of the sheave. The speed control apparatus also comprises a speed detector 130 for detecting a rotation speed of the sheave of the inertial system 120 and a load detector 140 for detecting a load of the cage driven by

the inertial system 120. The speed detector 130 generates a speed detecting signal Wr' indicative of the detected rotation speed of the sheave. The speed detecting signal Wr' is applied to a subtractor 111 which is adapted to subtract the speed detecting signal Wr' from a speed command signal Wr* outputted from a speed control computer (not shown) and output the resultant value as a speed deviation signal. The speed control apparatus also comprises a proportional integrator 112 for proportionally integrating the speed deviation signal from the subtractor 111 and outputting the resultant value as a control signal T*, a notch filter 113 for receiving the output signal from the proportional integrator 112, removing a particular frequency from the received signal and sending the signal free of the particular frequency to the motor driving circuit of the inertial system 120 as a torque-controlling current command signal for controlling a rotation speed Wr of the motor, and a vibration control circuit 114. The vibration control circuit 114 is adapted to detect a position of the cage, based on the speed detecting signal Wr' from the speed detector 130, operate a natural vibration frequency of the rope and thimble rod spring, based on the output signal T* from the proportional integrator 112, derive a frequency with a peak gain from the operated natural vibration frequencies as a removal frequency, store the derived removal frequency in a table, together with a cage position corresponding thereto,

read a removal frequency corresponding to a required cage position, from the table, correct the cage load detected by the load detector 140, based on the read removal frequency and operate the natural vibration frequency again, based on the corrected cage load, and vary the constant of the transfer function of the notch filter 11, based on the correctly operated natural vibration frequency and a predetermined removal frequency bandwidth.

The vibration control circuit 114 may be a microcomputer.

The present invention also provides a method for controlling the elevator speed using the vibration control circuit 114. In accordance with the method, first, a determination is made about whether the current operation is a test operation for measuring respective natural vibration frequencies corresponding to cage positions or a normal operation. Where the current operation is the test operation, predetermined spaced cage positions are detected while driving the elevator cage throughout the stroke length thereof. Simultaneously, a natural vibration frequency of the rope and thimble rod spring at each detected cage position is operated. Then, each cage position and the operated natural vibration frequency corresponding thereto are stored in a table. Where the current operation is the normal operation, a natural vibration frequency corresponding to a required cage position is read from the table in which respective vibration

frequencies corresponding to all cage positions have been previously stored during the test operation. In this case, the read natural vibration frequency is then corrected and operated again, based on the cage load. Thereafter, the constant of the transfer function of the notch filter is varied, based on the corrected and operated natural vibration frequency.

Now, the present invention will be described in detail, in conjunction with its operation and effects. This description is also made, in conjunction with a graph of FIG. 4 illustrating a relationship between a gain and a frequency, a graph of FIG. 5 illustrating a relationship between the rope length and the natural vibration frequency, a diagram of FIG. 6 illustrating a characteristic of the notch filter, a diagram of FIG. 7 illustrating a gain characteristic depending on a vibration restraint, and a flow chart of FIG. 8 illustrating a vibration restraint operation.

When the elevator is operated as a speed command signal is outputted from the speed control computer (not shown), the rotation speed of the sheave of inertial system 120 is detected as a real speed of the elevator by the speed detector 130 which, in turn, outputs a speed detecting signal Wr'. This speed detecting signal Wr' is subtracted from a speed command signal Wr* outputted from the speed control computer, in the subtractor 111. The resultant value is then

proportionally integrated in the proportional integrator 112.

Where the current operation is a test operation for measuring natural vibration frequencies upon installing the elevator, the proportional integrator 112 generates its output directly as a torque-controlling current command signal, without sending the output to the notch filter 113, so as to drive the motor of inertial system 120. By the rotation of motor, the sheave rotates and thus the cage is driven to move vertically.

Upon this test operation, the vibration control circuit 114 detects one of predetermined spaced cage positions, based on the speed detecting signal outputted from the speed detector 130. The vibration control circuit 114 also receives the signal outputted from the proportional integrator 112 correspondingly to the cage position. For the received signal, the vibration control circuit 114 executes a fast Fourier transform (F.F.T.) so that it derives gains of frequencies caused by the vibration of the cage 60. From the derived gains, the vibration control circuit 114 finds a frequency with a peak gain corresponding to a peak vibration as a removal frequency. Since the speed detecting signal outputted from the speed detector 130 is a pulse signal, the rope length can be derived by accumulating the number of pulses of the speed detecting signal and then integrating the resultant value. Based on the speed detecting signal,

accordingly, a corresponding cage position can be detected. Thereafter, the cage position and the removal frequency are stored in an internal memory of the vibration control circuit 114.

Next, the cage position detection and the removal frequency operation utilizing the fast Fourier transform are repeated for next cage position. These procedures are repeated for all predetermined cage positions. The derived cage positions and the removal frequencies derived correspondingly thereto are stored in the table.

Where the elevator is operated at the normal state, after completing its installation and the preparation of the table including removal frequencies based on respective cage positions derived by the measurements of natural vibration frequencies, the subtractor 11 subtracts the speed detecting signal Wr' of the speed detector 130 from the speed command signal Wr* and sends the resultant signal to the proportional integrator 112. In the proportional integrator 112, the signal is proportionally integrated and then sent to the notch filter 113. In the notch filter 113, a gain of a particular frequency of an output signal from the proportional integrator 112 is attenuated and then sent to the motor driving circuit of inertial system 120 as a torque-controlling current command signal.

In this case, the vibration control circuit 114 detects

the current cage position, based on the speed detecting signal of the speed detecting circuit 130. Also, the vibration control circuit 114 reads a removal frequency corresponding to the detected cage position, using the table in which removal frequencies for various cage positions have been previously stored upon the test operation. On the other hand, the cage load is detected by the load detector 140 disposed at the bottom of the cage 60. Based on the detected cage load, the vibration control circuit 114 corrects and operates the removal frequency, so as to derive a natural vibration frequency fo corresponding to the cage position. Subsequently, it varies the constant Wo of the transfer function $G_N(S)$ of the notch filter 113, based on the derived natural vibration frequency and the bandwidth of the removal frequency.

Since the natural vibration frequency is varied, depending on the position of the cage 60, that is, the rope length and the cage weight, where only the notch filter 113 is used, the vibration control circuit 114 varies the constant of the transfer function of notch filter 113, based on the cage position and the cage weight. Accordingly, the vibration frequency occurring at the rope and thimble rod spring is efficiently attenuated, thereby restraining the vibration occurring at the cage 60.

In accordance with another embodiment of the present

invention, the real speed Wr of the elevator which is used for operating the position of cage 60 in the vibration control circuit 114 is detected as a position signal by a sensor disposed on a travelling path along which the cage moves vertically. In this case, the inertial system 120 can be controlled to restrain the vibration occurring at the cage 60, by reading a removal frequency stored in the memory.

As apparent from the abcve description, the present invention provides an effect of effectively restraining a vibration occurring due to variations in cage mass and rope length, by integrating the traveling speed of a cage upon installing the elevator, to operate various positions of the elevator and record natural vibration frequencies corresponding to respective positions, and by detecting the load of the cage when the elevator is operated at a normal state, to automatically vary the natural vibration frequency.

Although the preferred embodiments of the invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

CLAIMS:

1. An apparatus for controlling a speed of an elevator comprising:

a subtractor for subtracting a speed detecting signal from a speed command signal;

a proportional integrator for proportionally integrating an output signal from said subtractor;

a notch filter for removing a particular frequency component from an output signal from said proportional integrator and outputting said signal free of said particular frequency component as a torque-controlling current command signal; and

vibration control means for varying a constant of a transfer function of said notch filter, based on a position of a cage equipped in the elevator and a load of said cage.

2. An apparatus in accordance with claim 1, wherein said vibration control means is a microcomputer which is adapted to receive a speed detecting signal indicative of a sheave equipped in the elevator, a load detecting signal indicative of said load of the cage and an output signal from the proportional integrator, vary said constant, based on said received signals, and send the varied constant to the notch filter.

3. A method of controlling a speed of an elevator comprising the steps of:

a) determining whether a current operation is a test operation for measuring respective natural vibration frequencies corresponding to cage positions or a normal operation;

b) if said current operation is said test operation, storing, in a table, a removal frequency of natural vibration frequencies of a rope and thimble rod spring at each position of a cage equipped in the elevator while controlling a speed of a driving motor equipped in said elevator without using a notch filter;

c) if the current operation is said normal operation, varying a constant of a transfer function of said notch filter, based on a current position of a cage equipped in the elevator and a current load of said cage;

said step (b) comprising:

detecting cage positions at predetermined intervals;

operating natural vibration frequencies through a fast Fourier transform for a signal obtained by proportionally integrating a signal indicative of a difference between a speed command signal and a speed detecting signal both generated for each of said cage positions; and

finding a removal frequency from said natural

vibration frequencies for each cage position and storing said removal frequency in said table, together with each cage position corresponding thereto; and

said step (c) comprising:

detecting said current cage position and said current cage load;

reading a removal frequency previously stored in the table and corresponding the current cage position;

correcting and operating said read removal frequency corresponding to the current cage position, based on the current cage load; and

varying said constant of said transfer function, based on said corrected and operated frequency and a bandwidth of said removal frequency previously stored.

4. A method in accordance with claim 3, wherein said step (a) comprises a step of integrating said speed detecting signal for each cage position.

5. A method in accordance with claim 3, wherein said step (a) comprises a step of detecting each cage position, based on a position detecting signal outputted from a position detecting sensor disposed on a travelling path.

6. A method in accordance with claim 3, wherein said

removal frequency for each cage position corresponds to a frequency with a peak gain selected from natural vibration frequencies for each cage position.

7. An apparatus for controlling the speed of an elevator substantially as hereinbefore described with reference to and as illustrated in Figs 3 to 8 of the accompanying drawings.

8. A method of controlling a speed of an elevator substantially as described with reference to Figs 3 to 8 of the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number
GB 9309541.2

Relevant Technical fields

(i) UK Cl (Edition L) G3N (GDA, GDB, GD) GBR (RBN)

(ii) Int Cl (Edition 5) B66B G05D

Databases (see over)

(i) UK Patent Office

(ii) WPI

Search Examiner
MR D A SIMPSON

Date of Search
1 JULY 1993

Documents considered relevant following a search in respect of claims 1-8

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
	NONE	

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

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